

# **Conducting a Critical Interpretive Synthesis on Poppers Literature: The influence of the medical model of health on our understanding of alkyl nitrites**

**by  
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## **Abstract**

Poppers (alkyl nitrites) are vasodilators used by many gay men to relieve pain, enhance pleasure, and facilitate penetration during sex. Poppers have been studied by medical researchers since the 1980s, yet community-based and qualitative research remain uncommon. I conducted a critical interpretive synthesis examining the ways that the dominant medical model of health is influencing poppers literature. Analysis was performed using close coding of five papers, resulting in two constructs termed “responsible action” and “risk ratchetting”. Responsible action describes a bias in poppers research, resulting from researchers’ own senses of duty. Researcher duty is motivated not just by objective measures of risk, but by harmful stereotypes of gay men and people who use drugs. Risk ratcheting refers to aspects of academia that result in exaggeration of poppers-related risk over time. These constructs may provide a lens to more critically understand the poppers literature, and other bodies of marginal drug literature.

**Keywords:** Poppers; Alkyl Nitrites; Critical Interpretive Synthesis; Queer Health; Gay Men’s Health;

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## List of Acronyms

(to be updated)

AIDS	Acquired Immune Deficiency Syndrome
CIS	Critical Interpretive Synthesis
CBPR	Community-Based Participatory Research
GBMSM	Gay, bisexual, and other men who have sex with men
GHB	Gamma-hydroxybutyrate
HIV	Human Immunodeficiency Virus
HPV	Human Papilloma Virus
MDMA	3,4-Methylenedioxymethamphetamine
PWUD	People who use drugs
PrEP	Pre-Exposure Prophylaxis
STI	Sexually Transmitted Infection

# Introduction

## Project Genesis

Poppers, or alkyl nitrite products, have been a common fixture in gay men's culture since the 1970's (Lowry, 1982). As short acting vasodilators, they result in a head rush and the relaxation of smooth muscle when inhaled (Lowry, 1982). A natural consequence is that these products relax the anal sphincter, making anal sex easier and less painful. Though poppers have predominantly existed as a niche drug among gay, bisexual, and other men who have sex with men (GBMSM) since their initial popularization, they are occasionally used outside this demographic (R. French & Power, 1998). The sale of poppers was banned in Canada in 2013 according to the Food and Drugs Act (Health Canada, n.d.)(R.S., 1985), however little information was published in relation to this policy decision.

The current project arose out of a scoping review on poppers done in partnership with Len Tooley, at the Community-Based Research Centre, a GBMSM health organization in Vancouver, British Columbia. To gain perspective on the federal ban of poppers products, I reviewed what is currently known about poppers: their history, their effects, and their health benefits and consequences. Literature was identified from several countries of origin, spanning from the late 1970s to present day, however the vast majority of available literature was biomedical in focus. Predominantly, the findings of this review identified poppers-related harm (see below, "Health Impacts of Poppers Use").

Throughout this process of review, I was quick to notice a discrepancy between perceptions of researchers and those of the GBMSM community. While published literature focused almost exclusively on the negative health outcomes of poppers,

community members generally felt that the positive effect these products had on pleasure and sex-life were beneficial to their overall health.

As a gay man wanting to best serve the community, I found myself struggling with the findings of this review. On the one hand, the available literature did identify specific harms associated with poppers use which are valuable to be aware of. On the other hand, the overwhelmingly negative portrayal of poppers in the academic literature contrasts with community knowledge about their potential benefits and their standing as an important aspect of GBMSM culture. These contrasting perceptions seemed to me to present barriers to the application of published knowledge. Fundamentally different values between researchers and community stakeholders seemed to suggest divergent goals with respect to policy and health interventions. Currently, despite a reasonably large and continually growing body of knowledge, a high prevalence of poppers use, and a contested federal policy, public health efforts to better understand and engage with poppers use remain few and far between.

## **Background**

### **Health Impacts of Poppers Use**

According to academic literature, poppers users' self-reported health effects include headaches and skin irritation (Lowry, 1982)(Lowry, 1979)(R. S. French & Power, 1997). More extensive research on poppers has also shown a moderate, temporary decrease in CD3+ T cell count (Dax, Adlei, Nagel, & Lange, 1991) which may have implications for the body's immune response. Reported cases exist for poppers-induced overdose and central vision blindness (Docherty, Eslami, & O'donnell, 2017; Finnerty,

Rewsbury, Hughes, & Clarke, 2016; Gruener, Jeffries, El Housseini, & Whitefield, 2014), though overdose is exceedingly rare (Lowry, 1982), and central vision blindness appears to be associated with isopropyl nitrite, a specific chemical that has entered the poppers-supply since the banning of traditional amyl and isobutyl nitrite poppers (Finnerty et al., 2016; Gruener et al., 2014; Rewbury, Hughes, Purbrick, Prior, & Baron, 2017). The most pervasive health claim, however, is that poppers may facilitate transmission of viral sexually transmitted infections (STIs), notably HIV (Romanelli, Smith, Thornton, & Pomeroy, 2004).

Poppers initially gained academic notoriety in the early 1980s during the start of the AIDS crisis. Because they were used almost exclusively by GBMSM and were associated with sexual behavior, they received significant attention from epidemiologist and biomedical researchers. While the discovery of HIV soon dismissed poppers as a causal factor in the development of AIDS, potential harms from poppers use continued to be studied. Much of this research, including the implication of poppers in the etiology of Kaposi's sarcoma, was contested due to an inability to rule out confounding sexual practices (Grimson, 1990; Kramer, 1990). However, models controlling for previous STI diagnoses suggest that poppers do increase the chance of viral STI transmission (Seage et al., 1992). Hypothesized explanations for increased transmission rates include increased likelihood of blood vessel rupture due to vasodilation, temporary decrease in immune function, or facilitation of "more forceful anal penetration" (Wilson, 1999), thus facilitating entry of the virus into the bloodstream through abrasions and cuts in the anal tissue (World Health Organization [WHO], 2019).

## **Understanding Poppers beyond a Medical Approach**

Guided by initial investigation by epidemiologists and biomedical researchers during the early 1980s, the bulk of academic publications exploring poppers align with a medical model of health, defining health strictly as the absence of disease (Larson, 1999). This model guides researchers to focus specifically on the way poppers use may be causing harm. Other models of health, like the one put forward by the WHO offer a different perspective. The WHO model refers to health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (World Health Organization [WHO], 2006). Using this model of health, poppers could be recognized as benefitting health by enabling sexual intimacy or increasing pleasure, and their impact on the community could be understood in a broader way outside just the context of pathology.

Considering recent advances in sexual health response, it may be particularly relevant now, to examine the way we view health in relation to poppers use. While academic publications on poppers are dominated by research relating to HIV and viral STI transmission, a diversity of new preventative tools exist to address these problems including pre-exposure prophylaxis (PrEP), HIV treatment as prevention (TasP), and highly effective HPV vaccines. As a result of these prevention options, many who use poppers during sex are not at risk for viral transmission in the way they may have been before. Given these circumstances, a contextualization of existing poppers literature may be warranted now more than ever.

## **The Current Project**

Using the medical model of health as a contextual lens, the current paper seeks to explore academic literature on poppers as it relates to the lived experiences of GBMSM. Through the process of critical review, I aim to locate existing biomedical knowledge in relation to strength-based understandings of poppers use. In light of poppers-related benefits, notably the facilitation of pleasure and sexual intimacy, I investigate the application and interpretation of medically informed poppers research, paying particular attention to the way notions of risk are constructed.

The process of critical review used here differs from traditional review in that it does not seek to aggregate and summarize evidence. Rather, inductive reasoning is used to understand existing research in context. In the current paper, I apply critical interpretive synthesis (CIS), a critical review methodology, to published poppers literature. As gray literature on poppers is sparse and outdated, therefore less relevant for policy and health interventions, published literature is defined here as articles published in peer-reviewed journals. While CIS does not demand a static research question, the goal of this analysis revolves around the following question: What aspects of the medical model of health may be creating barriers to the implementation of poppers research in communities of GBMSM?

## **Methods:**

### **Purpose and Objectives**

As suggested above, the purpose of this work is to better understand the influence of the medical model of health on poppers research, as it relates to the lived experiences of GBMSM. In order to accomplish this goal within the timeframe appropriate for a capstone project, objectives were outlined as follows:

1. Perform close coding of 5 published research papers on poppers. Close coding is a process of categorizing text according to emerging ideas. Words, or short phrases, are assigned to text as 'codes'.
2. Critically reflect on emerging concepts throughout the process of analysis, including re-coding papers and revisiting memos.
3. Characterize the relationship of emerging concepts according to similarities that exist between them (lines-of-argument synthesis), and apparent contradictions (refutational synthesis).
4. Describe the synthetic constructs (see below, Critical Interpretive Synthesis) that emerge from these data.

### **Critical Interpretive Synthesis**

Rather than aggregate existing data, CIS, first described by Dixon-Woods et al (2006) aims to transform existing evidence into a new conceptual form. Instead of testing a hypothesis, the goal of CIS is to begin generating theory from the data. As such, the methods vary significantly from those of aggregative reviews. Instead of defining the bounds of the review using a fixed research question, CIS treats the research question as "a compass rather than an anchor, and as something that [is] not finally settled until the end of the review" (Dixon-Woods et al., 2006). This process of reflexivity is extended

throughout the process of data collection and analysis. Data is added throughout the process of analysis and emerging results are continually tested against available evidence. Notably, while CIS is based on methods of qualitative synthesis including meta-ethnography, it is intended to be applied to all types of evidence, not just qualitative research. Thus, it can be effectively applied to the traditionally quantitative biomedical research that makes up most of poppers literature.

The outputs of CIS, termed synthetic constructs, are relatable to higher order constructs used in meta-ethnography. As Dixon-woods et al describe, “Synthetic constructs are grounded in the evidence, but result from an interpretation of the whole of that evidence, and allow the possibility of several disparate aspects of a phenomenon being unified in a more useful and explanatory way.” (Dixon-Woods et al., 2006). Following the methods outlined by CIS, this review aimed to generate synthetic constructs using medically informed poppers literature as data (see below, Analysis and Creation of Synthetic Constructs).

## **Literature search**

Papers informing this review were initially identified based on search terms outlined in the previous scoping review. Articles were identified in PubMed and Google Scholar using search terms such as “poppers” “alkyl nitrite\*”, “Amyl nitrite”, “Isobutyl Nitrite”, and “Inhaled nitrites”. These papers were supplemented with recommendations from colleagues and supervisors, and papers deemed to be relevant through citation chaining. Citation chaining describes the identification of literature through papers cited by, or papers that cite, a paper known to be relevant. This process expanded relevant papers to include literature on drug policy, queer theory, and medical anthropology.



## **Analysis and Creation of Synthetic Constructs**

To ensure outputs of the current project would be completed on a reasonable timeframe, initial analyses were conducted using close coding of 5 papers identified from the initial search (see Table 1). These papers were chosen for analysis using purposive sampling, based on those expected to give the richest data. Factors influencing purposive sampling included citation count, and the date of publication.

While papers varied across countries of origin, and study types, they were consistent in their focus on the problems of poppers use. These papers included a review on poppers-related health, cross-sectional and longitudinal studies looking at poppers-related harm, a descriptive statistics paper outlining populations in which poppers are used, and a paper introducing a psychological expectancy scale relating to poppers use. Authors' backgrounds varied, but each research team had strong representation from the medical sciences.

Following methods outlined by Annandale et al (2007), this initial pool of data was expanded using theoretical sampling. Theoretical sampling refers to the addition of new data that is specifically sought out in light of emerging theory, for the purposes of expanding and testing its development (Coyne, 1997). Examples of theoretically sampled papers in this analysis include papers published more recently than those initially coded, as well as sets of philosophical papers that focused on concepts relating to the analysis, such as stigma and power. Most of these subsequent papers are not included below, as they were abundant, diverse in nature, and not coded closely during the analysis.

Rather than focus on results of these studies as an aggregative review might, the process of coding in this analysis focused most heavily on the way poppers were described in the literature, and the recommendations that were made as a result of the research. Codes included, for example, “associating poppers with morality”, and “making clinical recommendations”. These codes were organized using NVivo12 (QSR International, 2018).

<b>Author(s), Date</b>	<b>Citation</b>	<b>Country of Origin</b>	<b>Researcher Backgrounds</b>	<b>Style</b>
Beck, Guignard, and Richard, 2004	(Beck, Guignard, & Richard, 2014)	France	Addictions medicine, Statistics, Epidemiology	Descriptive statistics paper
Dutta <i>et al</i> , 2017	(Dutta <i>et al</i> , 2017)	United States	Cancer immunology, virology, Infectious disease medicine	Cohort Study
Mullens <i>et al</i> , 2011	(Mullens, Young, Dunne, & Norton, 2011)	Australia	Clinical psychology, Psychopathology, Health promotion, LGBT health	Methods paper
Romanelli <i>et al</i> , 2004	(Romanelli <i>et al</i> , 2004)	United States	Pharmacy, Infectious Disease medicine, HIV prevention	Epidemiologic review
Wang <i>et al</i> , 2015	(Wang <i>et al</i> , 2015)	China	Infectious Disease Epidemiology, HIV prevention,	Cross- sectional study

			Epidemiologic statistics, LGBT health, mental health,	
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**Table 1: Papers coded for analysis.**

*Researcher backgrounds were determined based on academic affiliations, publication histories, and ResearchGate profiles for each co-author.*

As the process of coding continued, more general trends across the papers were observed. For example, I noticed that each paper portrayed a profound necessity for behavior change, and abstinence was portrayed as a primary goal. However, among these trends were some surprising oversights. Notably, while poppers risk centralized around HIV or viral STI transmission, poppers abstinence was generally recommended without discussing condoms, sex among seroconcordant partners, or poppers use in non-sexual contexts. Reflecting on these findings, and apparent oversights in researcher recommendations, I began approaching the data in a new way. I started to group codes into more abstract categories, and started to make notes about the way research questions may have been formed. Constant comparison was performed between the codes, the categories, and the data, eventually resulting in refined categories that became the synthetic constructs described in the results of this review.

This process was guided by the use of lines-of-argument synthesis and refutational synthesis. As Dixon-Woods *et al* note (Dixon-Woods et al., 2006), lines-of-argument synthesis involves integrating evidence across papers whereas refutational synthesis involves examining contradictions between them. As CIS methodology suggests, theory generated throughout this process was continually questioned and refined, as suggested by grounded theory (Glaser & Strauss, 1967).

## **Integrating Emotion into the Analysis**

In the process of coding papers, there were times when I found myself responding emotionally to the views of researchers. I felt angry and frustrated by homophobic language and by claims that were made without proper evidence. Some papers included in this review were conducted during the early AIDS crisis, and often the opinions of researchers were marked by heterosexist worldviews that suggested (and continue to suggest) that queer experiences, and queer forms of sex, were abnormal. Following suggestions from McFerran et al (McFerran, Hense, Medcalf, Murphy, & Fairchild, 2017), I reflected on these emotional responses and incorporated them into the process of analysis. I paid particular attention to the ways emotion could have been affecting my conclusions. Given that I was analyzing this data as an individual rather than within a team, this process of emotional reflexivity was particularly relevant in understanding my own bias.

## Results

Findings from this critical review suggest that, though the medical model of health offers a useful framework to understand the side-effects of poppers use, systematic biases in the literature complicate the application of resultant knowledge. Two synthetic constructs identified in this analysis, responsible action and risk ratcheting, help explain this phenomenon. Responsible action describes the way that researchers' personal senses of duty are biased by stereotypes relating to gay men and people who use drugs (PWUD). Risk ratcheting, a concept introduced by other authors (see Crouch & Omenn, 2012; Stevens & Measham, 2014), describes how systematic trends in publication tend to gratuitously heighten perceived risks relating to poppers use. Both responsible action and risk ratcheting appear to create barriers to the practical application of research findings by unnecessarily emphasizing poppers abstinence and devaluing harm reduction informed, sex-positive responses to poppers-related health.

## Towards a Theory of Responsibility

In producing research pertaining specifically to people who use poppers, medically informed researchers, whether explicitly acknowledged or not, assume some sense of responsibility to the health of these individuals. However, this perception of responsibility seems to extend beyond just the amelioration of health problems. Researchers' portray a sense of responsibility to change poppers users' behavior that, while based on health risks, is altered by harmful assumptions about GBMSM and PWUD.

In a 2004 review on the effects of poppers use, Romanelli *et al* recommended the

following:

*"Practitioners should be familiar with the effects of nitrite inhalation and the associated risks. Patients, and particularly MSM and those with a history of drug abuse, should be questioned with regard to nitrite use. Regular abusers should be referred to appropriate substance abuse specialists, and all users should receive detailed counseling regarding the potential effects of inhalation and the correspondent risks."* (Romanelli et al., 2004)

While the goal of these recommendations is presumably to increase health outcomes, this passage is quite striking considering that poppers are not known to be addictive, and their associated risks are largely avoidable through safer sex practices.

This analysis suggests that social narratives surrounding substance use and anal sex bias researchers to heighten their subjective perceptions of risk. In addition, homophobic perceptions of GBMSM and stigma relating to substance use may allow for extreme recommendations that may not otherwise be considered socially acceptable. Generally, responsible action in the context of poppers literature can be understood as a product not just of objective measures of risk (as the medical model might suggest), but of subjective perceptions, as well as socially appropriate responses, to risk (See Fig. 1). In the following sections, I describe the influence of these social factors in greater detail.

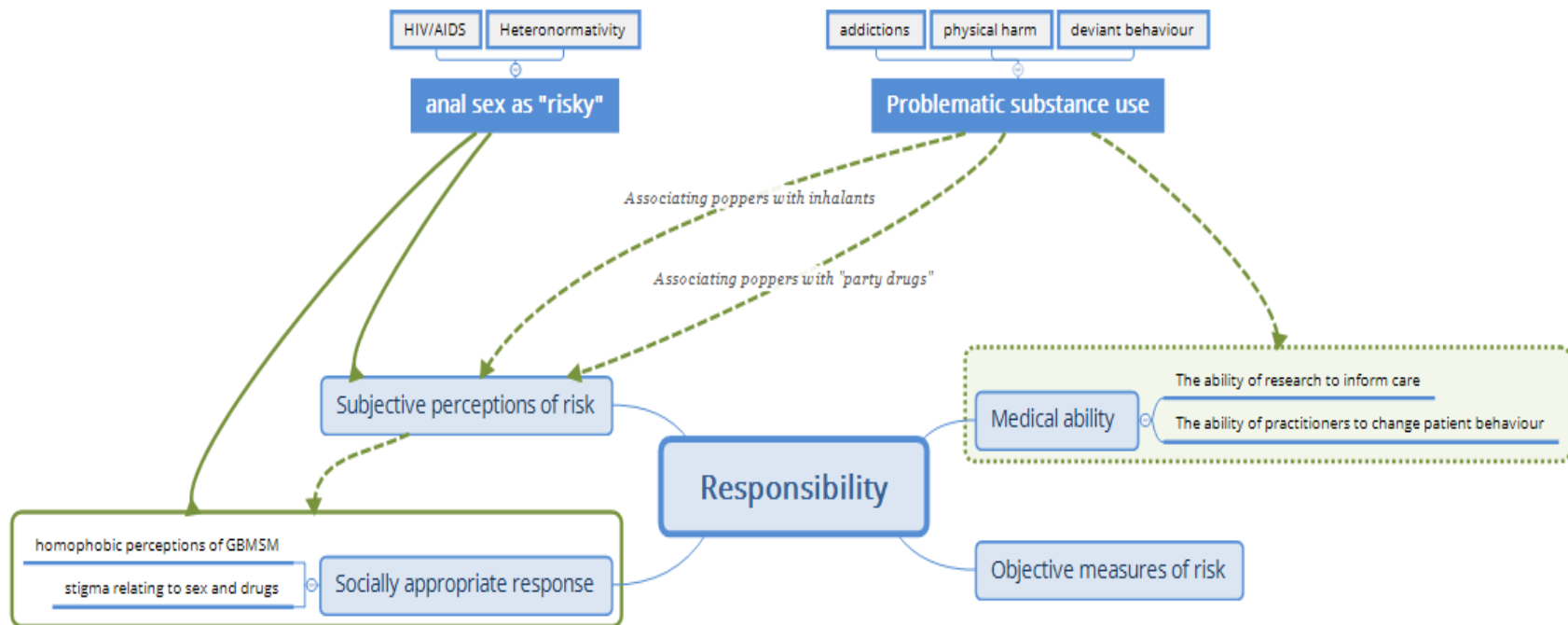


Figure 1: Synthetic Construct of Responsibility

*Responsibility reflects a duty experienced by medical researchers to elucidate poppers-related harm that is informed by objective measures of risk along with subjective societal influences.*

Notably, the idea of responsible action proposed here is distinct from the previous theories of responsibility, including Kinsman's writings on responsibility in the response to HIV/AIDS (Kinsman, 1996). In 1996, Gary Kinsman published a paper describing the way ideas of responsibility (and conversely irresponsibility) were formed among gay men in response to HIV in Ontario. Kinsman describes the ways in which perceived irresponsibility among GBMSM communities was seen as justification for poor response to the HIV epidemic from researchers, policy makers, and public health practitioners. While Kinsman focuses on the sense of responsibility health professionals placed on gay communities, the current theory provides a different perspective, informed by researchers' constructions of their own responsibility in the context of poppers-related health.



## Responsibility and “substance abuse”

Assumptions about substance use featured strongly in the concept of responsibility formed in this analysis. These assumptions are evident, for example, in researchers' reference to the use of poppers as “poppers abuse”. As mentioned above, there is negligible support for poppers-related dependence or addictive behavior, and low poppers-related harm outside of viral STI/HIV transmission. Referring to all poppers use as “abuse” reflects an assumption that poppers are inherently unhealthy, independent of published findings or individuals' motivation to use them.

More broadly, bias towards a harmful conceptualization of poppers is evident in the categorization of poppers as an illicit drug. In the context of medical research, drugs are typically characterized as either causing harm (illicit substances) or preventing harm (prescription medication). Literature on poppers almost unanimously places poppers in the former category, despite past medical uses, most notably as medication for angina pectoris (Nossaman, Nossaman, & Kadowitz, 2010). As a result, poppers are often introduced in association with inhalants (i.e., “huffing” solvents, gasoline, etc.), or with “party drugs” such as MDMA, GBH, ketamine, or methamphetamine. However, it is well accepted that drug harms correlate poorly with licit or illicit status on an international scale (Morgan et al., 2013)(Nutt, King, & Phillips, 2010). Discussing poppers in this context may gratuitously worsen subjective conceptualizations of poppers risk, tying in irrelevant harms relating to drug use.

Associated bias may further impact research through assumptions about poppers users themselves. In introducing poppers, Romanelli *et al* write:

*Drugs such as [MDMA], [GHB], methamphetamine, and ketamine are popular substances of abuse... In some instances, these club drugs have been used to facilitate date rape. Inhaled nitrites (“poppers”) are also a common class of drugs that have a long history of being abused in social settings, particularly among gay and bisexual men.*

(Romanelli et al., 2004)

The discussion of poppers alongside narratives of drug-facilitated sexual assault, particularly considering poppers are not known to be used this way, suggests researchers are influenced by harmful stereotypes of PWUD themselves, including the perception that PWUD are amoral.

The above assumptions influence researcher responsibility by exaggerating the perceived necessity for intervention. In their 2004 review of poppers-related health, Romanelli *et al* go on to suggest the following:

*For HIV-infected patients, considerations should be given to the effects of inhaled nitrites on adherence to antiretroviral drug regimens. Although the rush created by nitrites appears to be short-lived, long-term abuse of these agents places the patient at risk of missed antiretroviral doses, thus facilitating the development of resistant viral strains* (Romanelli et al., 2004)

Suggesting that abstinence from poppers may be necessary to adhere to HIV treatment regimens implies that poppers users are incapable of managing their own health. Poppers use is portrayed here as something that is all-consuming, and something that threatens not only personal health, but the ability of public health to respond to HIV/AIDS.

While some evidence suggests the use of substances such as cocaine and heroin can predict adherence to antiretroviral medication (Martini et al., 2004), there is no reason to suggest this is true of poppers use. Poppers are a considered a drug according to Canadian legislature (R.S., 1985)(Hansen, 2014), however they do not cross the blood brain barrier (Advisory Council on the Misuse of Drugs, 2016) and because their effects last approximately less than one minute, they should have no influence on individuals' ability to adhere to medication regimens.

False perceptions of poppers use like these create barriers to the implementation of research in a number of ways. First, they may recreate harmful and offensive stereotypes of people who use poppers, and in this case, people who are HIV positive. Recommendations made with these stereotypes in mind do not properly reflect reality and are unlikely to provide benefit to the GBMSM community. This altered sense of responsibility also presents barriers to the integration of sex positive and harm reduction-informed responses to poppers use. If poppers use is portrayed as inherently harmful, amoral, or all-consuming, there is little room for health responses that reflect the benefits of poppers known to the community.

## **Responsibility and Heteronormativity**

Bias resulting from heteronormativity also appears to alter the sense of responsibility assumed by poppers researchers. As medical anthropologist Kane Race notes, medical research generally relies on a state of “normal” functioning to contextualize drug-related harm. However, this idea of normal is influenced significantly by societal norms like heteronormativity (Race, 2009). Considering GBMSM may conceptualize health deficit differently than straight populations, and differences in sexual behavior naturally mean a different risk profile than that of the general population, the responsibility researchers feel to change GBMSM behavior may conflict with the self-identified needs of GBMSM.

Perhaps the most obvious way that responsibility is influenced by heteronormativity within the medical model of health is through the definition of the health issue as resulting from poppers’ side-effects, and not resulting from pain during

anal sex. While there is an understanding among researchers that poppers products are used to facilitate anal sex, there is generally no recognition that the discomfort they address is a problem warranting medical consideration. As a result, poppers use is seen as frivolous, and strength based approaches to poppers are seen as unjustified.

The following excerpt from Mullens *et al.* further illustrates the way that this heteronormativity sense of responsibility may be creating barriers for knowledge users:

*"Interventions and health promotion ... could focus on helping MSM to reduce their need for desired consequences [of poppers] (e.g., finding other creative means to enhance sex that do not focus on amyl nitrite use, sexual risk reduction practices such as mutual masturbation instead of UAI [unprotected anal intercourse]). Health promotion could also focus on reinforcing negative consequences of use (e.g., amyl nitrite use makes it difficult to interact with others). ... Focusing on, both, reducing use and modifying expectancies could be a useful target in relation to HIV prevention efforts."* (Mullens et al., 2011)

Recommendation to modify poppers-related expectancies and encourage "creative" sexual alternatives suggest a heteronormative approach to health that does not validate penetrative sex among GBMSM. As such, suggestions like mutual masturbation may be found unrealistic or unhelpful by GBMSM who use poppers. Notably, the recommendations above stemmed from perceived difficulties in sexual negotiation (*i.e.*, discussing condom use) when using poppers. While these aspects of poppers use are worth considering, recommendations made without careful consideration of heteronormative bias may disempower poppers users, contrary to the suggestion of health promotion.

## **Responsibility and HIV/AIDS History**

Along with substance use and heteronormativity, the history of the GBMSM health

movement should be considered with respect to the construction of researcher responsibility. In particular, the formative influence of HIV/AIDS on the field may help to explain power dynamics and a focus on STIs that bias responsible action in contemporary literature on poppers.

While this history of HIV/AIDS has been marked by continual activism from the GBMSM community, it is also shadowed by a power difference between researchers and queer men. The sheer magnitude of public health concern that AIDS presented (and continues to present in many contexts), along with social politics in the 1980s and 1990s that discouraged researchers to be out as gay, has set precedent for external medical intervention in GBMSM lives. The general consequences of historic medicalization on queer research and wellbeing have been discussed elsewhere (Conrad & Angell, 2004; Eckhert, 2016; Wahlert, 2012). For the purposes of the current analysis, it may be worth considering that this history of medical responsibility may also bias perceptions of poppers researchers to be overly attentive to potential harms.

Naturally, this same trend may help to explain why HIV and STI's dominate the academic discourse on poppers. Given the profound influence of HIV on research in GBMSM health, a sense of researcher responsibility has been maintained that is primarily dominated by HIV and STIs. While this work continues to be valuable, it is also necessary to recognize the ways this focus may bias available literature. As Hottes, Ferlatte, and Gesink note, publications focusing on GBMSM men and HIV outnumber publications on suicide ten to one, despite the fact that suicide has surpassed HIV as a risk for mortality in this population (Hottes, Ferlatte, & Gesink, 2015). To echo the sentiment of these researchers, the importance of HIV as a contemporary issue in the field should not be understated, however it is reasonable to expect that the dominance of HIV is similarly influencing researcher responsibility with respect to poppers use.

## Risk Ratcheting

Along with researcher responsibility, a second theoretical construct that can be applied to poppers research is risk ratcheting. Risk ratcheting, or the tendency of perceived risk to rise and be upheld, has been described in a number of health fields. The theory of the drug policy ratchet, proposed by Stevens and Measham (Stevens & Measham, 2014), describes a sense of ratcheting in international drug policy, in which drugs tend to be controlled more strictly over time, without objective justification. Risk ratcheting has also been used to characterize the way risk of carcinogenicity is translated from animal models to humans (Crouch & Omenn, 2012), or more generally through the phenomenon of publication bias in which negative study findings are unlikely to be published (Easterbrook, Gopalan, Berlin, & Matthews, 1991). Similarly, in the case of poppers research, continual research appears to further entrench poppers as a source of worse and worse harm, while discussions of poppers benefits go unpublished.

In their 1993 book describing a diversity of psychoactive substances, Weil and Rosen wrote the following:

*"All nitrites are poisonous in excess, but amyl nitrite, when inhaled, breaks down easily and leaves the body very quickly. It is considered one of the safest drugs in medicine, and even people who inhaled it frequently do not seem to suffer ill effects,"*(Weil & Rosen, 1993)

Considering that the portrayal of poppers in this book aligns with feelings of many GBMSM, who consider poppers generally safe, what causes a high-risk profile to be maintained so rigidly in contemporary academia? In part, this trend may be explained given the medical model's focus on health detriment intersecting with the concept of

publication bias. It is also worth considering that many of the biases affecting responsible action (*i.e.*, stereotypes of substance use, heteronormativity) may also be impacting decisions of research funders and journal editors to support research that upholds a high sense of risk. These trends are not entirely new. Anthropologist David Moore describes a similar pattern in which the pursuit of funding has resulted in a capitalistic drive in health research to publish on the risk factors of illicit drugs, and not on their benefits (Moore, 2008).

In the case of poppers research specifically, it is perhaps the marginality of the issue, and its relative obscurity within academic work that allows this ratcheting of risk to be so extraordinary. Like Moore suggests, objective risk is obscured in all illicit drug literature, however in the case of poppers use, poor public understanding of the issue and an infrequent publication record make it difficult for authors to recognize the contrasting perceptions between academia and the GBMSM community. In part, this may also be influenced by a tendency for researchers and policy makers in HIV work to distance themselves from in-depth conversation around taboo topics such as sex and drug use (Race, 2016).

In the context of this analysis, risk ratcheting should be understood in parallel with the construct of responsibility, acting as both a consequence of, and a driver for, the aforementioned construct. While responsible action provides a lens to observe subjectivity among individual researchers or research teams, risk ratcheting characterizes factors within academic institutions that are systematically supporting this bias. Without a recognition of the influence of risk ratcheting, it may be more difficult to make effective recommendations, or inform health programming related to poppers use.

# Discussion

## Implications

While the results of this review identify problems with the medical model of health as applied to poppers research, this should not be interpreted as a dismissal of medically informed literature. Without this work, little would be known about the negative health implications of poppers. In any case, this medically-informed, deficit-focussed method of publication is likely going to remain dominant in the field of substance use literature. What is clear from this review, however, is that current literature on poppers is biased in ways that make it difficult to implement published knowledge.

In light of these findings, more should be done to integrate the lived experience of GBMSM in literature on poppers. Without the perspective provided by these individuals, the goal of medical research on poppers may be caught between contrasting definitions of health, confusing the process of knowledge implementation. This bears particular relevance considering that existing efforts to address poppers harm, including biomedical research and prohibitive legislation, have not generally been made based on request or upon consultation with GBMSM. By contextualizing poppers-related harm alongside community values, the focus of public health action in relation to poppers use may become more clear.

One strategy to improve the uptake of poppers research in community-led health response may be to encourage active, rather than passive, constructions of researcher responsibility. As this analysis suggests, when responsibility is assumed passively, or without careful consideration of its determinants, social bias may interfere with effective application of research findings. However, if responsibility could be understood as a process, in which its terms were actively defined, the resultant research may be more



easily integrated into health campaigns. This process of actively defining responsibility may occur, for example, through community-based participatory research methods, community engagement, reciprocal knowledge translation, and reflexivity on behalf of the research team.

Another strategy to avoid bias in poppers research may be to characterize poppers with respect to drugs of similar physiological properties, rather than illicit or licit status. Conceptualizing poppers in relation to other vasodilators, for example, may result in a medically informed sense of responsibility that is less driven by assumption relating to drug use. Furthermore, evidence supports the notion that researchers tend to overly standardize drug users experiences (Lee & Antin, 2011). Referring specifically to queer populations, it has been noted that substance use may reflect “a creative or experimental response to social minoritization – and not necessarily a problematic one in every instance” (Race, Lea, Murphy, & Pienaar, 2017). As such, qualitative research studies that describe personal experiences of poppers use may further help to address existing bias.

Generally, while the scope of this critical review has been limited to research on poppers, the findings presented here may have implications in other areas of research. This may include, for example, other research in GBMSM health and the health of marginalized populations who use substances. While not built expressly with other bodies of knowledge in mind, the concepts of researcher responsibility and risk ratcheting may help provide insight as to how biases manifest in these fields, and how best to move forward.

## **Limitations**

In order to properly contextualize the findings of this review, limitations in the study design should be recognized. While CIS methodology is traditionally performed using a review team (Dixon-Woods et al., 2006), I worked as an individual throughout the process of analysis. As a result, I did not have the time to properly analyse more than 5 papers in a comprehensive way. Additional resources would have allowed a more fulsome analysis, with greater confidence that data collection had reached saturation. Other reviewers would also have provided valuable perspectives in informing the process of analysis.

## Conclusion

Literature informed by a medical model of health has almost exclusively shaped academic understanding of poppers use. However, resulting recommendations based on the association between risk and sex raise questions relating to public health values. In order to move forward with health programming related to poppers use, it is necessary to address bias, not only within the medical model of health, but also in the way it is applied. The synthetic theoretical constructs of responsible action and risk ratcheting developed in this review may be useful in revealing this bias, both on an individual publication level and a systematic level. Generally, this review identified a need for more representation of people with lived experience of poppers use in the literature. Potential solutions include CBPR and reciprocal knowledge translation.

## Reflection

As a student without formal training in sociology or medical anthropology, writing the findings of this analysis was a challenge. I found myself wanting to write about a diversity of other concepts and theories that, while relevant, were outside the realistic bounds of this project. In starting to describe my results, I began writing about the philosophy of knowledge creation, the influence of neoliberalism on the motivations of researchers, and the distribution of power in relation to HIV response. I may not have had the ability or resources to successfully integrate all these concepts in writing, but they nonetheless served as a reminder of the complex influence of systems on public health practice.

In the process of reflection, I think it is valuable to consider that there is always more to know, and that scientific literature, though valuable, is subject to many of the same influences as broader society. As an aspiring public health practitioner, I am reminding myself that I should think of the voices and opinions that may not be at the table if the goal is to truly work for the health of the population.

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